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## Question: Problem 2 For the WT8 x 44.5 attached through its flange to a...

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### Problem 2

For the WT8 x 44.5 attached through its flange to a 12 x 3/4 in. plate with eight 7/8 in. bolts at a spacing of  $s = 3$  in. and placed in two rows as shown below, determine the shear lag factor (consider Case 2) and the effective net area of the WT section. Also, determine the design tensile strength using LRFD and the allowable tensile strength using ASD. Use A992 grade steel for this section. Note that the length of the connection is 9 in.

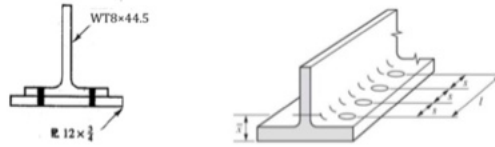


Figure for Problem 2

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## Expert Answer



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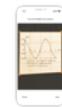
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Grade of Steel	= A992
Member designation	= WT8x44.5
Gross area of section	$A_g = 13.2 \text{ in}^2$
Thickness of flange	$t_f = 0.875 \text{ in.}$
Breadth of flange	$b_f = 6.4 \text{ in.}$
Depth of section	$d = 8.38 \text{ in.}$

### Connection Details

Member connected to web/flange = flange.

Diameter of bolt,  $d_b = 7/8 \text{ in.}$

Number of bolts across a section  $n = 2$ .

Pitch of the bolts  $s = 3 \text{ in.}$

Number of bolts in line  $m = 4$

Distance of Centroid from edge  $\bar{x} = 1.69 \text{ in.}$

### Calculation

For grade of steel, A992,

Yield stress,  $F_y = 50 \text{ ksi}$

Ultimate stress  $F_u = 65 \text{ ksi}$

Diameter of bolt hole  $d_h = 7/2 + 1/8$   
 $= 1 \text{ in.}$

### Design strength

#### Yielding in the gross section

Design strength of gross section is obtained as

$$\begin{aligned} \text{LRFD} \\ \phi_t F_n &= \phi_t F_y A_g \\ &= 0.9 \times 50 \times 13.2 \\ &= 594 \text{ kips} \end{aligned}$$

$$\begin{aligned} \text{ASD} \\ F_n &= \frac{F_y}{\Omega} A_g \\ &= 50 \times 13.200 \times 1.67 \\ &= 395.2 \text{ kips} \end{aligned}$$

#### Fracture in the net section

$$\begin{aligned} \text{Net area } A_n &= A_g - n(dnt) \\ &= 13.2 - 2 \times 1.000 \times 0.875 \\ &= 11.45 \text{ in}^2 \end{aligned}$$



Case-2:

shear lag factor,  $U = 1.0$  when connected both flange and web.

$$= 1 - \bar{x}/L \leq 0.9$$

where  $\bar{x}$  is distance of centroid from edge and  $L$  is the length of connection

length of connection in the direction of loading  
 $L = 9 \text{ in}$

Since the member is connected to flange

shear lag factor  $U = 1 - \bar{x}/L$   
 $= 0.812$   
 thus  $U = 0.900$

Alternative Value of  $U$   
 $b_f \geq 2/3 d \dots$   
 $U = 0.900$

Effective area,

$$A_e = U A_n$$

$$= 0.900 \times 11.45$$

$$= 10.31 \text{ in}^2$$

Design strength of net section is obtained as

LRFD

$$\phi_t F_n = \phi_t F_u A_e$$

$$= 0.75 \times 65 \times 10.305$$

$$= 502 \text{ kips}$$

ASD

$$F_n = \frac{F_u A_g}{\Omega}$$

$$= 65 \times 10.305 / 1.67$$

$$= 334.9 \text{ kips}$$

thus, the design strength of the member is the smaller of the two values, that is

LRFD

$$\phi_t F_n = 502.4 \text{ kips}$$

ASD

$$\phi_t F_n = 334.9 \text{ kips}$$

If you do not get anything in this solution, please put a comment and I will help you out.  
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and placed in two rows as shown, determine the shear lag factor (consider Case 2) and the effective net area of the WT section. Also, determine the design tensile strength using LRFD and the allowable tensile strength using ASD. Use A992 grade steel for this...

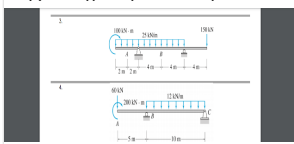
A: [See answer](#)

Q: For the WT8 x 44.5 attached through its flange to a 12 x 34 in. plate with eight 7/8 in. bolts at a spacing of  $s = 3$  in. and placed in two rows as shown below, determine the shear lag factor (consider Case 2) and the effective net area of the WT section. Also, determine the design tensile strength using LRFD and the allowable tensile strength using ASD. Use A992 grade steel for this...

A: [See answer](#) 100% (1 rating)

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4. Determine the minimum length of a crest vertical curve connecting a +4%

4. Determine the minimum length of a crest vertical curve connecting a +4% grade to a -4% grade. The design speed is 50 mph. The S>L assumption is correct.

[See answer](#)

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Q: Determine the available strength of a C8 x 11.5 attached through the web to a gusset plate with eight 7/8 in. bolts, in two lines of four bolts, at a 3 in. spacing. Use A36 steel. Considering yielding and net section rupture, determine the (a) design strength by LRFD and (b) allowable strength by ASD.

A: [See answer](#) 100% (2 ratings)

Q: For the WT8 x 44.5 attached through its flange to a 12 x 34 in. plate with eight 7/8 in. bolts at a spacing of  $s = 3$  in. and placed in two rows as shown below, determine the shear lag factor (consider Case 2) and the effective net area of the WT section. Also, determine the design tensile strength using LRFD and the allowable tensile strength using ASD. Use A992 grade steel for this...

A: [See answer](#) 100% (1 rating)

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